POLITECNICO DI MILANO

PhD in FISICA / PHYSICS - 37th cycle

THEMATIC Research Field: ULTRAFAST HOLOGRAPHIC MICROSCOPY

Monthly net income of PhDscholarship (max 36 months)
€ 1200.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	This fellowship will be in the framework of the Horizon Europe EIC Pathfinder project ulTRafast hOlograPHic FTIR microscopy (TROPHY). TROPHY's ambitious aim is to develop a radically new vibrational spectroscopic imaging microscope that will allow the evaluation of the cell morphology within tumour tissue, including topological information of different types of cells, mutant arrangement of cell clusters, and boundaries of cell clones, and will simultaneously provide a quantitative biochemical analysis to determine the tumor type (molecular subtyping, grading, and staging) accurately.For this vision to come true, we will blend elements of photo-thermal infrared (PT-IR), Fourier transform (FT)-IR, and Digital Holography Microscopy (DHM). TROPHY brings these techniques to the unprecedented ultrafast timescale, where the refractive index change induced by coherent IR vibrations is probed at its peak value before thermal relaxation. TROPHY borrows from PT-IR the combination of IR vibrational excitation with visible probing for high spatial resolution, from FT-IR the use of time-domain interferometry to obtain a high spectral resolution from broadband excitation, from DHM highly sensitive and quantitative detection of the refractive index (phase) change. Combined with artificial intelligence algorithms, this technology will enable quantitative concentration imaging of molecular biomarkers with high spatial resolution, high chemical selectivity and high speed, with a transformative impact on medical research and clinics.
Methods and techniques that will be developed and used to carry out the research	The scholar will develop a highly innovative ultrafast

	holographic microscopy technique and extend it to the mid -infrared range to visualize vibrational contrast in cells and tissues in order to determine their chemical composition. This research activity will combine concepts of nonlinear optics, microscopy and holography.
Educational objectives	The scholar will receive a multidisciplinary training in topics including nonlinear optics, holographic microscopy and biophysics. He/she will have the opportunity to visit partner laboratories in the EIC Pathfinder Trophy project.
Job opportunities	Due to the multidisciplinary training in cutting edge techniques of optics and photonics as well as biophysics and biomedicine, the scholar will have excellent job opportunities in high-tech industries. In addition, he/she will be well positioned for an academic career
Composition of the research group	2 Full Professors 2 Associated Professors 2 Assistant Professors 5 PhD Students
Name of the research directors	Marco Marangoni, Giulio Cerullo

Contacts
marco.marangoni@polimi.it *giulio.cerullo@polimi.it*

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	564.01 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
***Educational activities* per year :** 1st year: 0 2nd year: 1534 euros per student 3rd year: 1534 euros per student.

or 1022 euros per student for each year.

***Teaching assistantship*:**
There are various forms of financial aid for activities of support to the teaching practice.
The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: *individual use*
Desk availability: *shared use*